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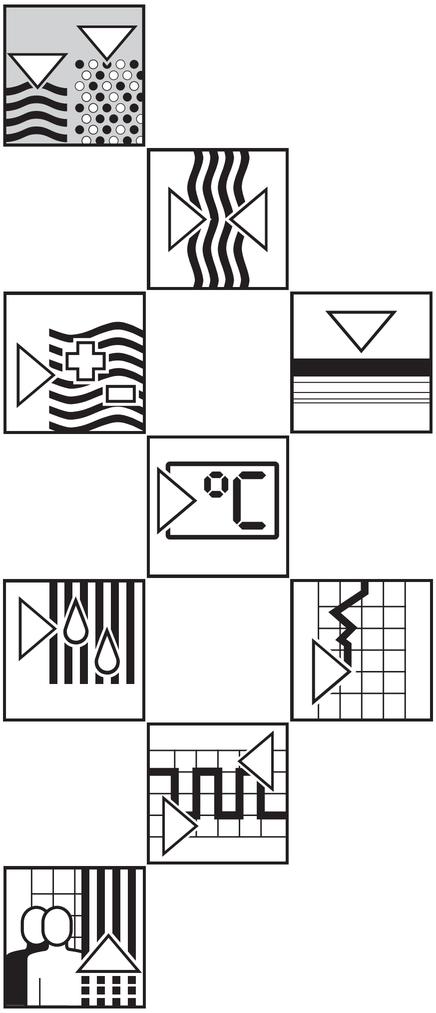
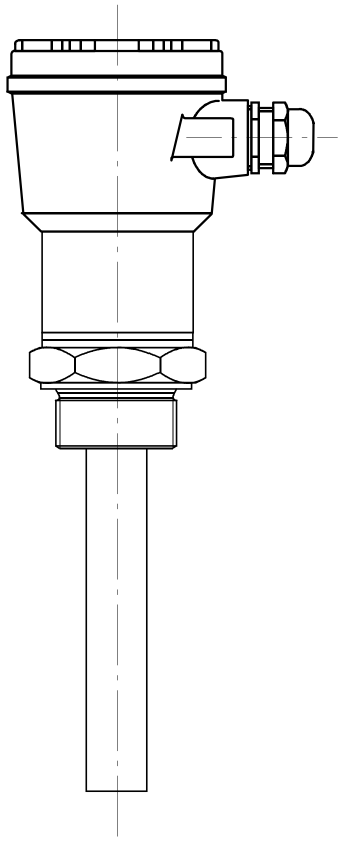
nivocompact
FTC 131
Level Limit Switch

Installation and Operating Manual





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Contents

Application

The Nivocompact FTC 131 is used for limit detection in silos containing bulk solids (for minimum or maximum indication).
For mounting laterally or from above.
Mainly for maximum detection of fine-grained or powdery bulk solids.
For minimum detection in small silos with light bulk solids.
For use in the food processing industry.

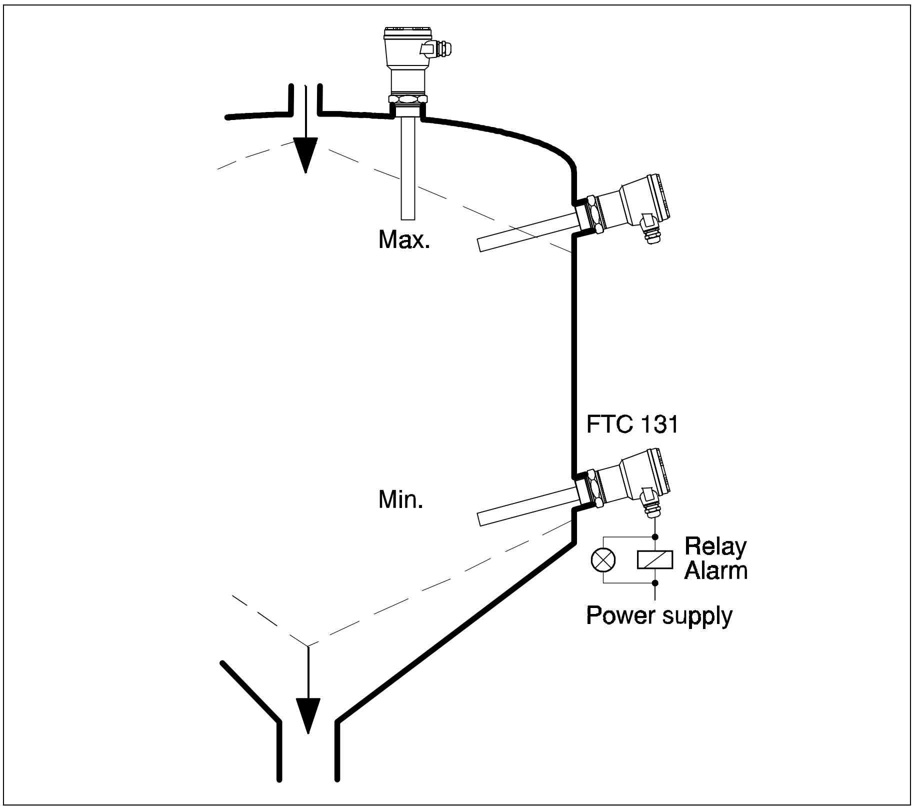


Fig. 1
Limit detection in bulk solid silos with the capacitive level limit switch Nivocompact FTC 131.

Application Examples

Sand	Glass aggregate	Gravel	Moulding sand
Lime	Ore, crushed	Plaster	Aluminium shavings
Cement	Grain	Pumice	Sugar beet chips
Dolomite	Flour	Kaolin	Fodder

and similar bulk solids.

Note:
Bulk solids should have dielectric constants $\varepsilon_r \geq 2.5$.

Please contact us for advice if the dielectric constant of the bulk solid is not known.

Technical Data

Operating Data

- Operating temperature in silo: –20 °C…+80 °C
- Operating pressure p_e depending on operating temperature: up to 10 bar
- Max. permissible load on probe: 30 Nm lateral
- Minimum dielectric constant ε_r of material: 2.5
- Ambient temperature for housing: –20 °C…+60 °C
- Storage temperature: –40 °C…+85 °C

Probe

- Material: steel rod
- Probe diameter: 25 mm
- Insulation: PE
- Thickness of insulation: 3.5 mm
- Electrical connection to bulk solid: fully insulated

Process Connections

- Parallel thread: G $1^1/_2$ A acc. to DIN ISO 228/I
- Tapered thread: NPT $1^1/_2$" acc. to ANSI B 1.20.1
- Material: steel or stainless steel 1.4571

Housing Versions

- Aluminium housing, IP 55
- Aluminium housing, IP 66
- Aluminium housing with synthetic coating, IP 66
- Synthetic housing in PBTP, IP 66
  (Protection IP… acc. to DIN 40050)

Cable Gland

- Housing IP 55: standard PG in nickel-plated brass with NBR gasket
  for cable diameter 7…10 mm
- Housing IP 66: water-tight PG in polyamide with Neoprene-CR gasket
  for cable diameter 5…12 mm

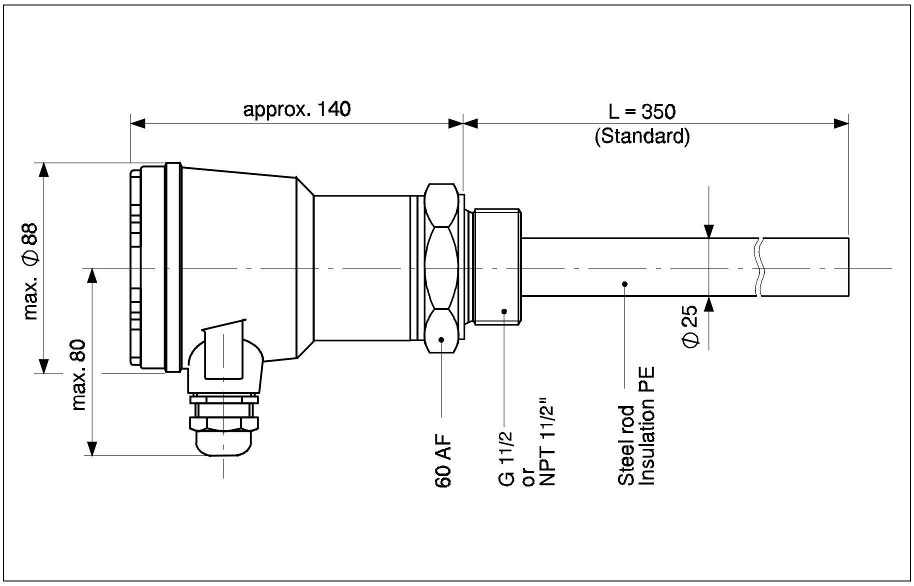


Fig. 2
Dimensions Nivocompact FTC 131.

Electronic Inserts

- Terminal connections: for max. 2.5 mm^2
- Measuring frequency: approx. 750 kHz for short probes up to 4 m, switchable to approx. 450 kHz for long probes
- Initial capacitance, adjustable: to approx. 400 pF
- Switching delay: approx. 0.5 s
- Minimum/maximum fail-safe switching: selectable with rotary switch
- Switching indication: red LED

Electronic Insert EC 20 for AC (Two-Wire Connection)

- Power supply U~: 21 V...250 V, 50/60 Hz
- Connected loads, short-term (max. 40 ms): max. 1.5 A; max. 375 VA at 250 V; max. 36 VA at 24 V
- Maximum voltage drop: 11 V
- Connected loads, continuous: max. 350 mA; max. 87 VA at 250 V; max. 8.4 VA at 24 V
- Minimum load current at 250 V:10 mA (2.5 VA)
- Minimum load current at 24 V: 20 mA (0.5 VA)
- No-load current (eff.): < 5 mA

Electronic Inserts EC 22 and EC 23 for DC (Three-Wire Connection)

- Power supply U =: 10 V...55 V
- Superimposed AC voltage U_{pp}: max. 5 V
- Current consumption: max. 15 mA
- Load connection: Open Collector; PNP (EC 22) or NPN (EC 23)
- Switching voltage: max. 55 V
- Connected load, short-term (max. 1 s): max. 1 A
- Connected load, continuous: max. 350 mA
- Residual current with transistor blocked: < 100 µA
- Protected against reverse polarity

Electronic Insert EC 24 for DC and AC (Relay Output)

- Power supply U =: 20 V...200 V
  or
  Power supply U~:21 V...250 V, 50/60 Hz
- Current consumption (eff.): max. 5 mA
- Peak inrush current: max. 200 mA, max. 5 ms
- Pulse current: max. 50 mA, max. 5 ms
- Pulse frequency: approx. 1.5 s
- Output: potential-free change-over contact
- Contact load capacity:
  U~ max. 250 V, I~ max. 6 A,
  P~ max. 1500 VA ($\cos\varphi = 1$) or P~ max. 750 VA, $\cos\varphi \geq 0.7$
  U= max. 100 V, I = max. 6 A, P = max. 200 W
- Operating life: min. 10^5 switchings at max. contact load
- Additional switching delay: max. 1.5 s

Type Key

See page 11 for order specification key and order code

Subject to modification.

Accessories

- Gasket for thread G $1^1/_2$ A:
  elastomer/fibre (asbestos-free) supplied
- Protective sun cover for aluminium housing
  Material: polyamide

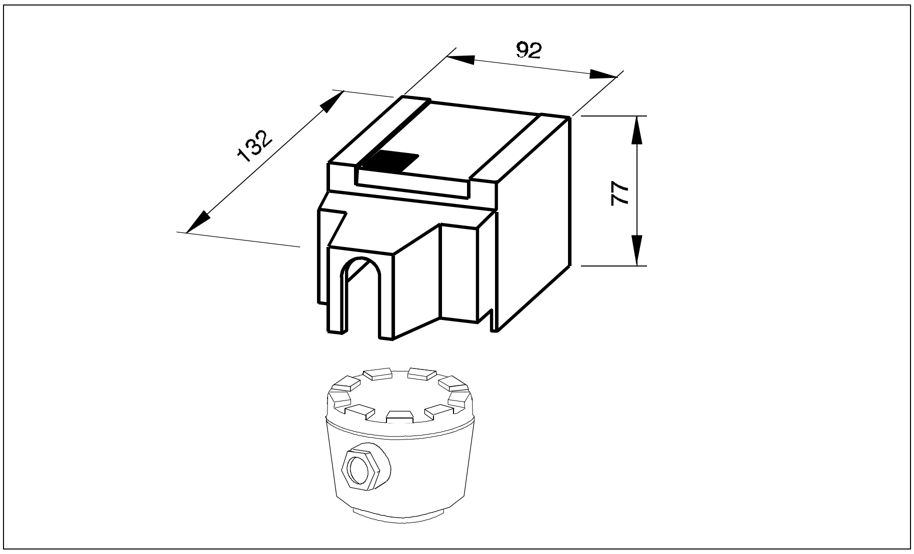


Fig. 3
Dimensions of protective sun cover (accessory).
This cover prevents condensation in the housing.

The Measuring System

The Nivocompact is an electronic switch.
The entire measuring system consists of:

- Nivocompact FTC 131
- power supply and
- connected control systems, switches, signal transmitters (e.g. process control systems, PLC, relays, microcontactors, lamps, sirens etc.)

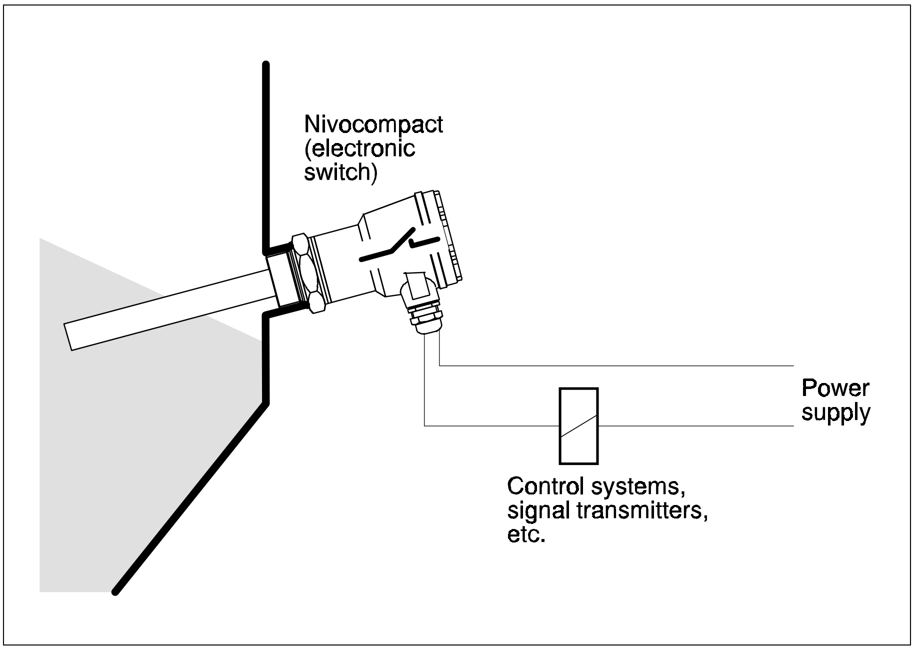


Fig. 4
The measuring system.

Function

The probe rod and the silo wall form the two electrodes of a capacitor with a high frequency voltage between them.
The limit value is based on the principle of a discharge circuit: As long as the probe is in air with a dielectric constant of $\varepsilon_r = 1$, then the discharge time constant is $\tau = R \times C_A$ where R is the resistance of the circuit and C_A the capacitance of the capacitor formed by the probe and silo wall.
If bulk material with a higher dielectric constant moves into the electrical field between the probe and silo wall, then the capacitance C_A increases and with it the time constant τ.
The change in the time constant is evaluated and the Nivocompact is activated according to its switching mode.
The Nivocompact is extremely insensitive to low build-up on the probe and silo wall as long as the material does not form a bridge between the probe and wall (e.g. on the threaded boss).

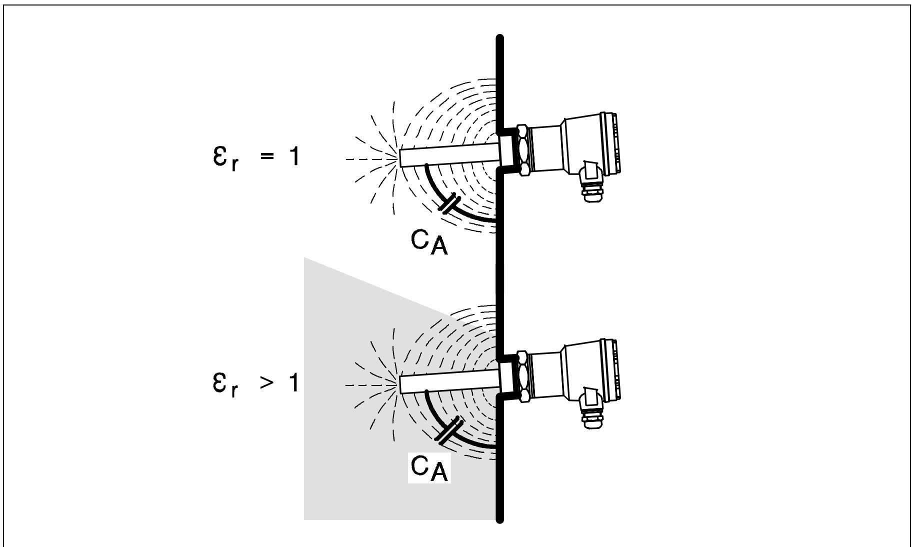


Fig. 5
The capacitor consisting of the silo wall and probe.

The built-in feature for minimum /maximum fail-safe switching allows the Nivocompact to be used in all applications requiring high operational safety:

Maximum Fail-Safe: The current circuit is blocked if the probe is covered or the power supply fails.

Minimum Fail-Safe: The current circuit is blocked if the probe is uncovered or the power supply fails.

A red LED on the electronic insert indicates switching status.

See also Fig. 22 in Section »Fail-Safe Switching«, Page 21.

Installation

Project Planning

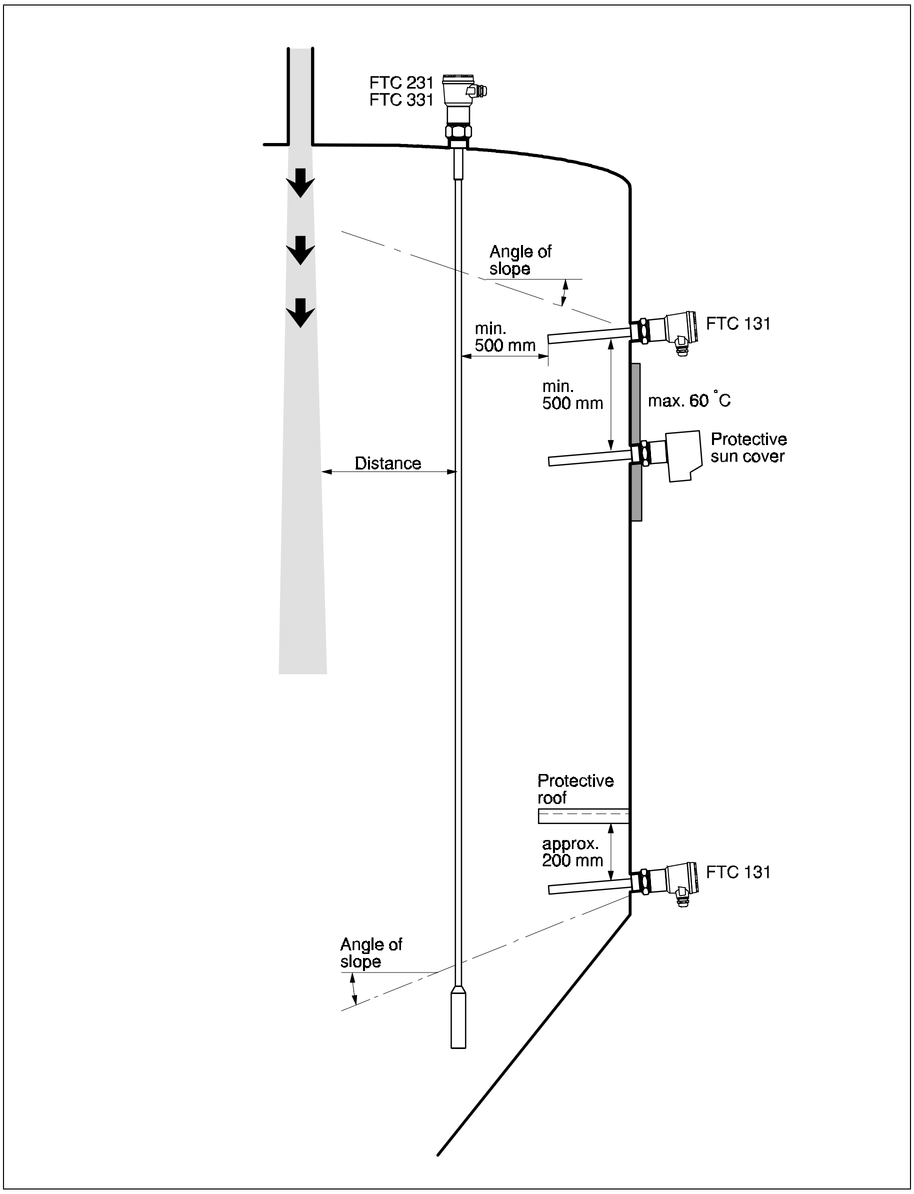


Fig. 6
General information for installing the capacitive Nivocompact FTC level limit switch.

Filling the Silo

The filling stream should not be directed onto the probe.

Angle of Material Flow

Note the angle of material flow or the outlet funnel when determining the measuring point.

Distance Between Probes

If more than one probe is mounted in a silo, then a minimum distance of 0.5 m must be allowed for in order to avoid mutual interference.

Threaded Socket For Mounting

Use the shortest possible threaded socket when mounting the Nivocompact FTC 131.
Condensation can form in long threaded sockets and interfere with correct operation of the probe.

Heat Insulation

With high silo temperatures:
Insulate the outside silo wall to avoid exceeding the max. permissible temperature of the Nivocompact housing.
This insulation also prevents condensation near the threaded boss and so reduces build-up and the danger of error switching.

Insulation in the Open

A protective sun cover as an accessory protects the Nivocompact with the aluminium housing from excessive temperatures and from condensation which may form in the housing due to large temperature variations.

Examples for Mounting

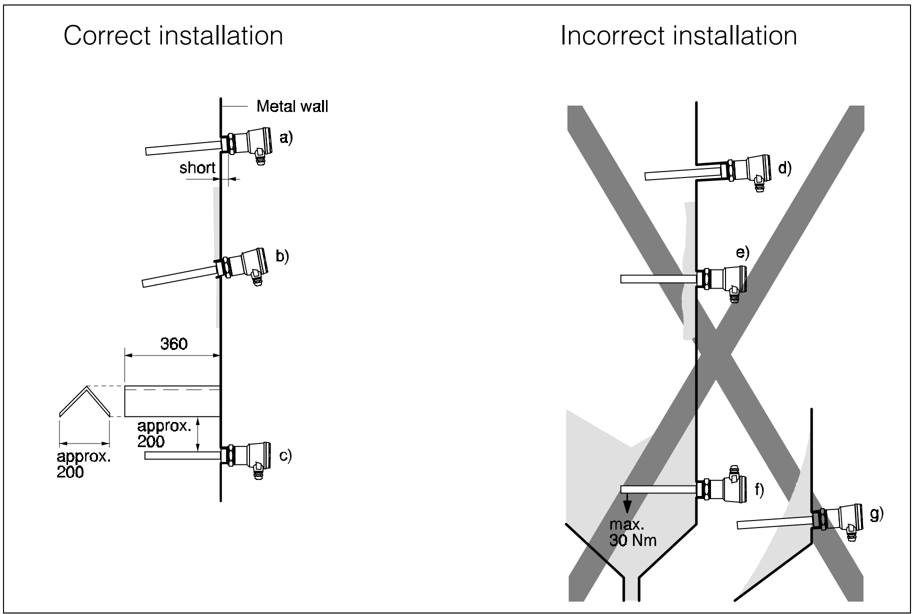


Fig. 7
Silo with metal walls.

Correct Installation

a) Maximum level detection;
short threaded socket (ideally 25 mm = half standard socket length)
b) Light build-up on silo wall: threaded socket welded internally.
The probe tip points slightly downwards so that material falls off more easily.
c) Protective roof to protect against collapsing mounds or high strain on the rod probe caused by the material filling curtain with the Nivocompact FTC 131 used for minimum detection.

Incorrect Installation

d) Threaded socket too long. Material can settle and lead to error.
e) Error switching caused by high build-up on the silo wall is best avoided by mounting the Nivocompact FTC 231 or 331 with rope probe in the roof of the silo.
f) High strain on the rod probe due to material run-out. The Nivocompact FTC 431 with disk probe is recommended.
Cable gland pointed upwards can allow moisture to enter.
g) In areas where material can settle, the instrument cannot recognise an »empty« silo. The FTC 231 or FTC 331 with rope probe is recommended.

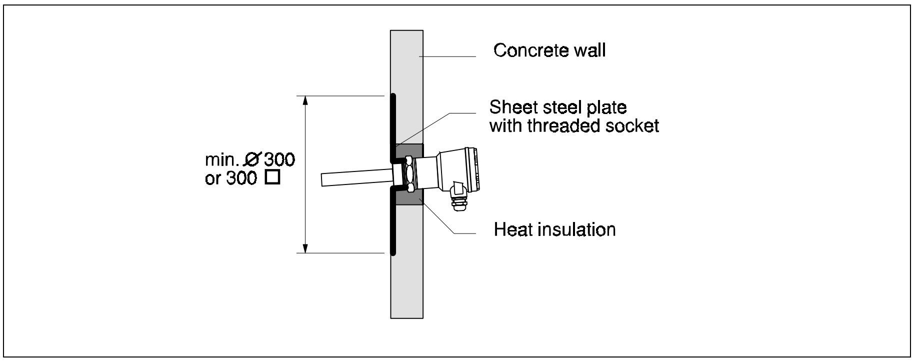


Fig. 8
Silo with concrete walls.

This mounting example shows a steel plate as counter electrode.
Heat insulation prevents condensation and build-up on the steel plate.

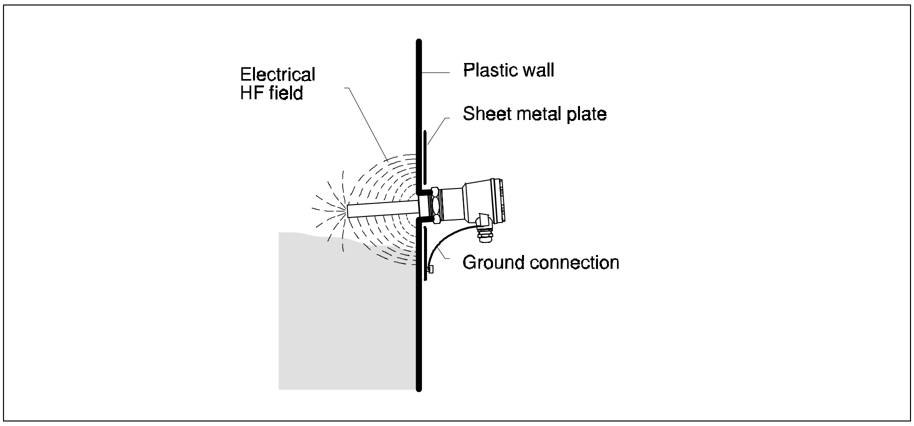


Fig. 9
Silo with plastic walls.

When mounting in a silo made of plastic material, a sheet metal plate should be attached to the outside of the silo as a counter electrode.
This plate can be either square or round. The dimensions with thin walls or wall materials with low dielectric constant should be approx. 0.5 m x 0.5 m or ø 0.5 m.
This should be approx. 0.7 m x 0.7 m or ø 0.7 m for silos with thicker walls or wall materials with higher dielectric constants.

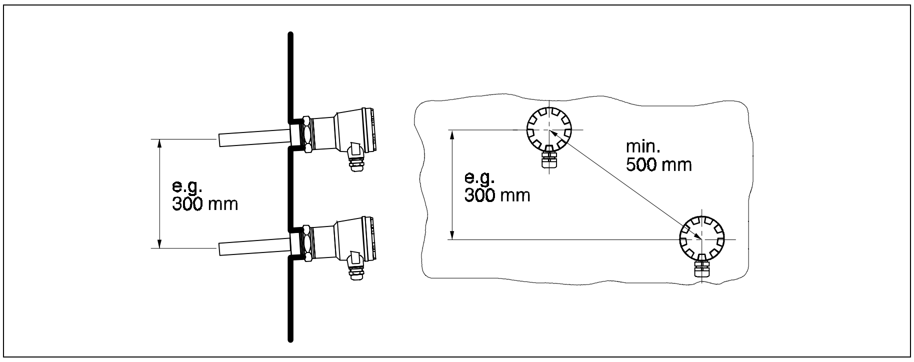


Fig. 10
For small level changes.

The minimum distance required can be maintained by staggered mounting.

Mounting

Tools Required for Installation

- Open-end spanner 60 AF
- Screwdriver, blade width 5 to 6 mm
  or Phillips screwdriver PZD 2

Preparation

Compare the order code on the nameplate of your instrument with the order specification key to ensure that the correct instrument is being installed.

FTC 131 capacitive level limit switch with rod probe, ø 25 mm

Process Connection
G Thread G $1^1/_2$, steel
H Thread NPT $1^1/_2$", steel
K Thread G $1^1/_2$, 1.4571
N Thread NPT $1^1/_2$", 1.4571
Y Others – check special version

Probe
3 350 mm probe length
9 Others – check special version

Housing
A Aluminium housing, IP 55
B Aluminium housing, IP 66
R Aluminium housing, coated, IP 66
K PBTP synthetic housing, IP 66
Y Others – check special version

Electronic Insert (mounted in housing)
1 21 V…250 V, 50/60 Hz (EC 20)
Two-wire AC connection
2 PNP 10 V…55 V= (EC 22)
Three-wire DC connection
3 NPN 10 V…55 V= (EC 23)
Three-wire DC connection
4 Relay, 21…250 V AC/200 V= (EC 24)
AC or DC connection
with relay output (change-over contact)
9 Others – check special version

FTC 131 | | | | | **Order code on nameplate**

Screwing In

FTC 131 with parallel thread G $1^1/_2$:
- Place the gasket supplied against the sealing surface
- When screwing in, turn the instrument by the 60 AF hex nut only!
- A torque moment of approx. 100 Nm is normally sufficient to produce a reliable seal to withstand pressures up to 10 bar.
  A torque of more than 300 Nm will destroy the seal.

FTC 131 with tapered thread NPT $1^1/_2$":
- Before screwing in, apply a suitable sealant around the tapered thread
- When screwing in, turn the instrument by the 60 AF hex nut only!

Rotating the Housing

The housing can be rotated if the cable gland is facing in the wrong direction after the Nivocompact has been securely screwed in:

Removing

- Unscrew and remove the housing cover
- Remove the central screw in the electronic insert
- Remove the plug-in electronic insert from the housing using the handle
- Slightly loosen the 3 screws in the housing, see Fig. 11

Rotating

- The housing can now be rotated through 360°;
  When mounting an FTC 131 laterally, the cable gland should point downwards so that no moisture can enter

Tightening

- Tighten up the 3 screws in the housing so that the housing is well sealed at the hex nut
- Insert the electronic insert in the plug
- Securely tighten the central mounting screw
  while making sure that the cable gland remains free

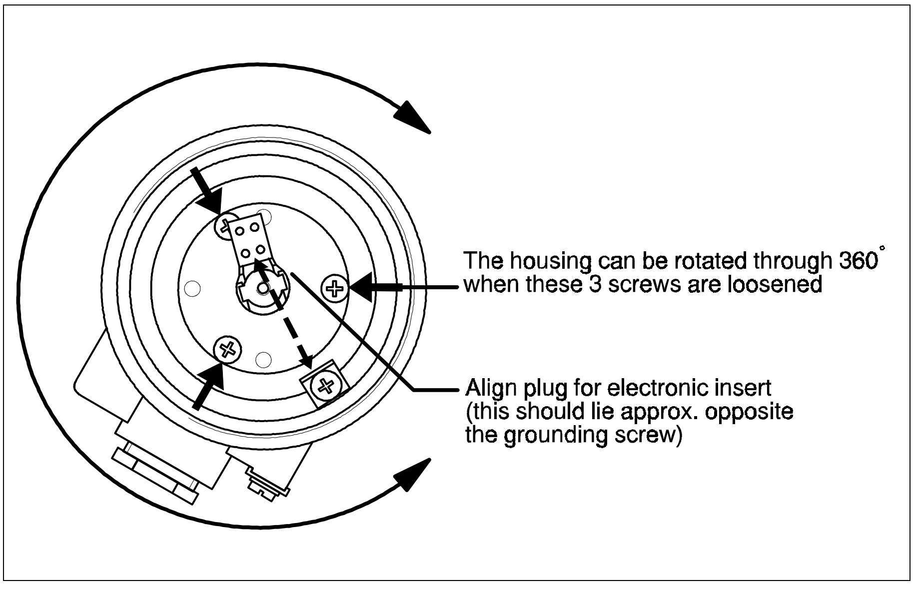


Fig. 11
Loosening and rotating the housing.

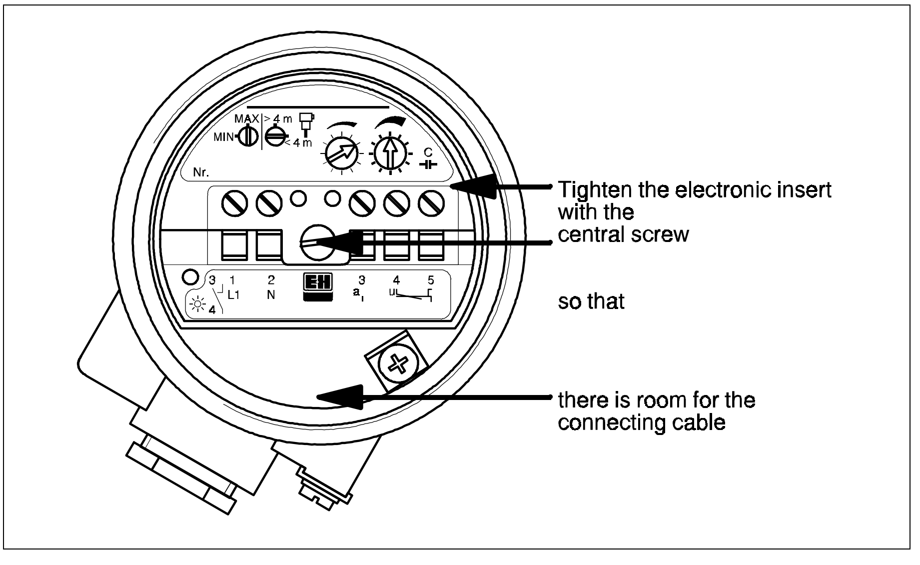


Fig. 12
Tightening the electronic insert.

Connection

Wiring Connection

Main Features of the Different Electronic Inserts

The last number of the order code on the nameplate identifies which type of electronic insert is mounted in the Nivocompact FTC 131:

1=Electronic insert EC 20
Two-wire AC; voltage: 21 V…250 V
Electronic switch, max. 350 mA

2=Electronic insert EC 22
Three-wire DC; voltage: 10 V…55 V
Transistor circuit, load connection PNP, max. 350 mA

3=Electronic insert EC 23
Three-wire DC; voltage: 10 V…55 V
Transistor circuit, load connection NPN, max. 350 mA

4=Electronic insert EC 24
with potential-free relay output
AC power supply 21 V…250 V or
DC power supply 20 V…200 V

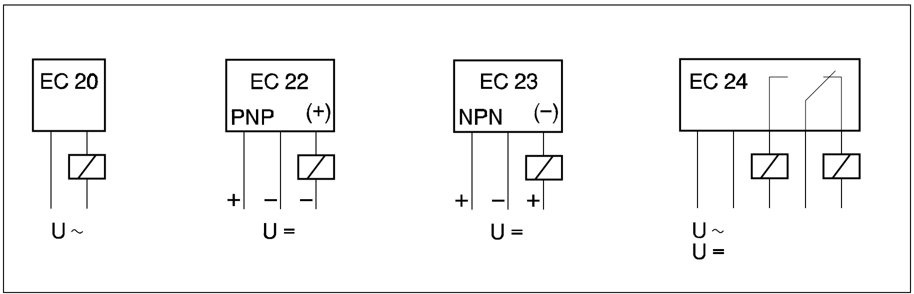


Fig. 13
Electrical connections available with the different electronic inserts.

Load Limit Values

Note the limit values of the loads to which you want to connect the Nivocompact. Exceeding the load can destroy the electronic insert (or the relay contact in the EC 24).

Fuse

Ensure that the rating of the fine-wire fuse corresponds to the maximum load to be connected.
The fine-wire fuse does not protect the electronic insert of the Nivocompact FTC 131.

Diameter of Wiring

Because of the small current used, only small diameter cabling is required. Low-cost cabling with diameters of 0.5 mm^2 to max. 1.5 mm^2 is recommended.

Grounding

The Nivocompact must be grounded to give reliable operation free from interference. This is done by either connecting it to a grounded silo with metal or reinforced concrete walls or else to the earth conductor PE.
If a counter electrode is connected to a silo made of plastic material, then there must be a short ground connection from the Nivocompact to the counter electrode.

Connecting the Nivocompact with Electronic Insert EC 20 for AC (Two-Wire Connection)

Connecting in Series to a Load

The level limit switch Nivocompact with electronic insert EC 20 must - like all switches - be connected in series with the load (e.g. relays, microcontactors, lamps) to the power supply.

⚠ Direct connection to the power supply without any intermediate load connected (short-circuit !) will result in immediate and permanent damage to the electronic insert.

The load can be connected to Terminal 1 or 2 of the electronic insert.
It is unimportant whether L1 is connected to Terminal 1 or 2.

Power Voltage

The voltage across Terminal 1 and 2 of the electronic insert must be at least 21 V.
The power voltage must be correspondingly higher to compensate for the voltage drop across the connected load.

Load Cutoff

Note that loads connected in series are not completely disconnected from the power supply if the electronic switch in the electronic insert of the Nivocompact »disconnects« (blocks) with level alarm.
Because of the current requirements of the electronics, a small »no-load current« still flows through the connected load.
When the load is a relay with a very small retaining current, then the relay may not de-energise. In this case connect an additional load in parallel to the relay, e.g. a resistor or signal lamp.

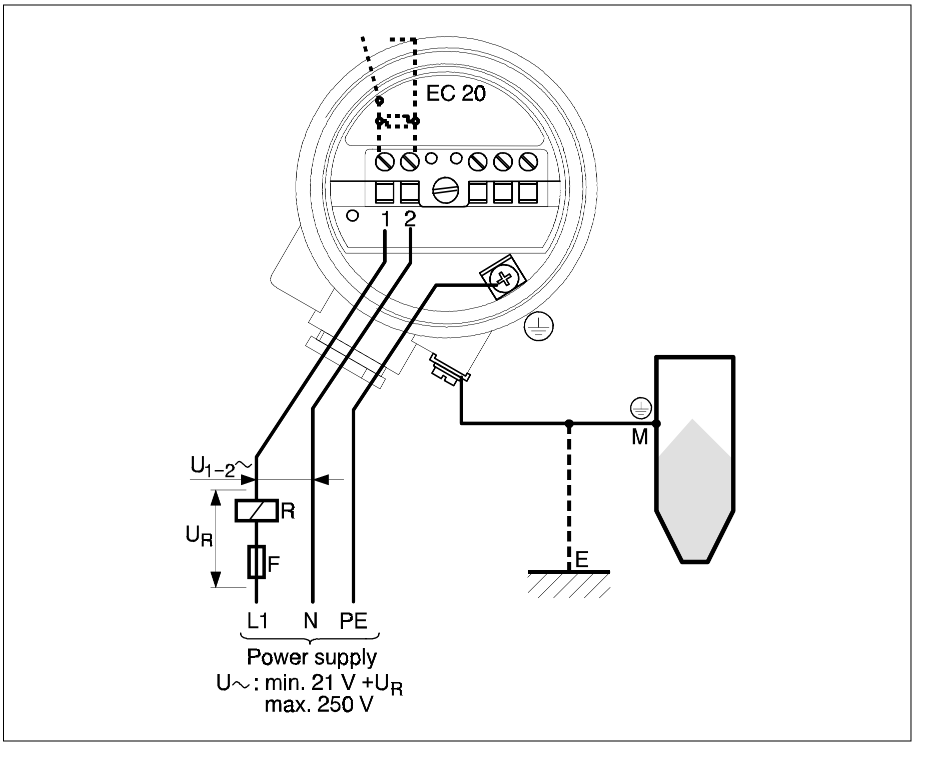


Fig. 14
Connecting the Nivocompact with electronic insert EC 20.

$U_{1-2\sim}$: 21 V…250 V across Terminals 1 and 2 of the EC 20
R: Connected (external) load, e.g. relay
F: Fine-wire fuse, load-dependent
U_R: Voltage drop across the load and the fine-wire fuse
M: Ground connection to silo or to counter electrode
E: Grounding

Connecting the Nivocompact with Electronic Insert EC 22 (Three-Wire PNP) for DC

Transistor Circuit for Load

The load connected to Terminal 3 is switched by a transistor, contactless and therefore without bouncing.

Terminal 3 has a **positive** signal in normal switching mode.

The transistor is blocked on level alarm or with a power failure.

Protection Against Voltage Peaks

Connecting to an instrument with a high inductance: a voltage limiter should be connected.

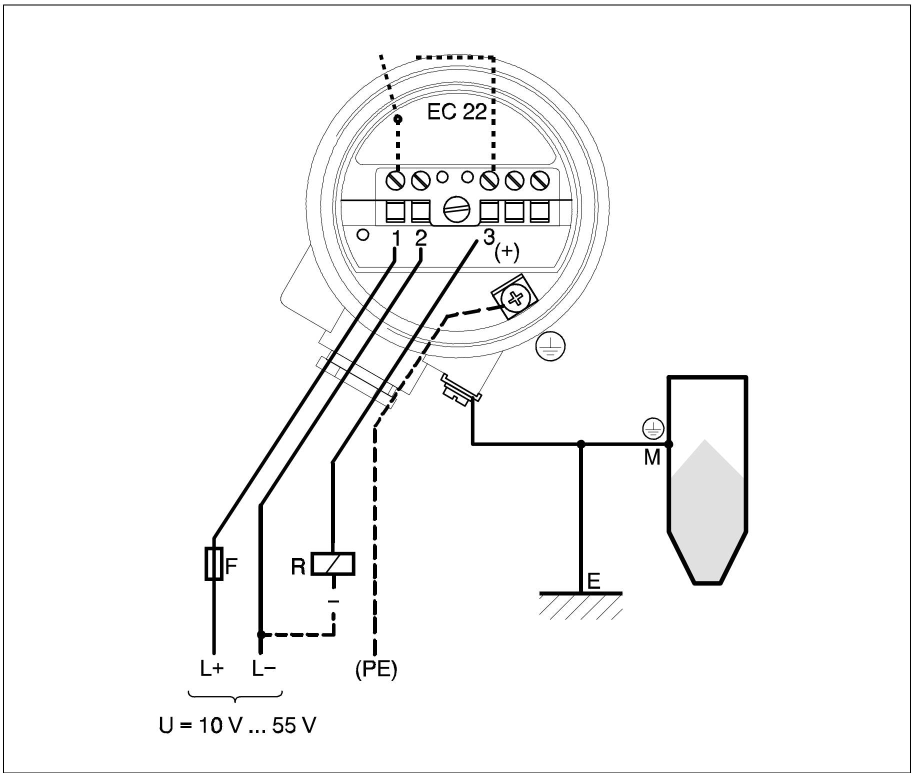


Fig. 15
Connecting the Nivocompact with electronic insert EC 22 (PNP connection).

F: Fine-wire fuse, load-dependent
R: Connected load, e.g. PLC, PCS, relay
M: Ground connection to silo or to counter electrode
E: Grounding

Connecting the Nivocompact with Electronic Insert EC 23 (Three-Wire NPN) for DC

Transistor Circuit for Load

The load connected to Terminal 3 is switched by a transistor, contactless and therefore without bouncing.

Terminal 3 has a **negative** signal in normal switching mode.

The transistor is blocked on level alarm or with a power failure.

Protection Against Voltage Peaks

Connecting to an instrument with a high inductance:
a voltage limiter should be connected.

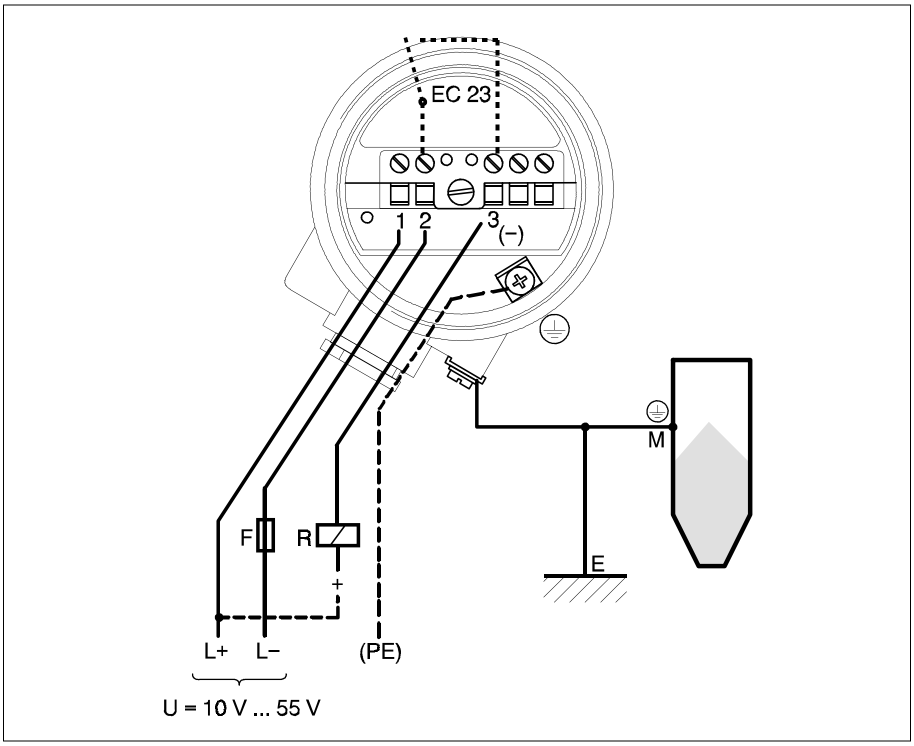


Fig. 16
Connecting the Nivocompact with electronic insert EC 23 (NPN connection).

F: Fine-wire fuse, load-dependent
R: Connected load, e.g. PLC, PCS, relay
M: Ground connection to silo or to counter electrode
E: Grounding

Connecting the Nivocompact with Electronic Insert EC 24 (Relay Output) for DC and AC

Power Supply

With AC, it is unimportant whether L1 or N is connected to Terminal 1.
With DC, it is unimportant whether L+ or L– is connected to Terminal 1.

Relay Contact for Load

The load is connected over a potential-free relay contact (change-over contact).
The relay contact breaks the connection between Terminal 3 and Terminal 4 on level alarm or with a power failure.

Protection Against Voltage Peaks and Short-Circuiting

Protect the relay contact by connecting a spark barrier to instruments with high inductance.
A fine-wire fuse (load-dependent) can protect the relay contact if a short-circuit occurs.

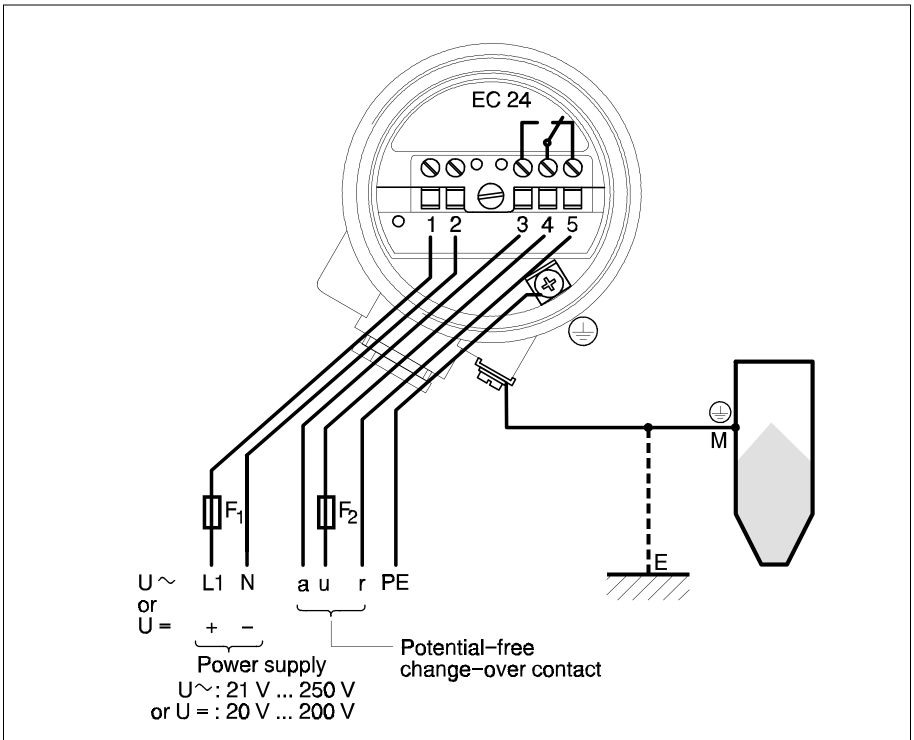


Fig. 17
Connecting the Nivocompact with electronic insert EC 24 (relay output)

F_1: Fine-wire fuse 200 mA, semi-time lag recommended
F_2: Fine-wire fuse to protect the relay contact, load dependent
M: Ground connection to silo or to counter electrode
E: Grounding

Wiring On-Site

Tools Required for Connection

- Screwdrivers, blade width approx. 4 mm and 7 mm or Phillips screwdriver PZD 1 and PZD 2
- Open-end spanner 22 AF
- Usual electrical tools

Before connecting, make sure that the power supply used is the same as that stated on the nameplate of the electronic insert.

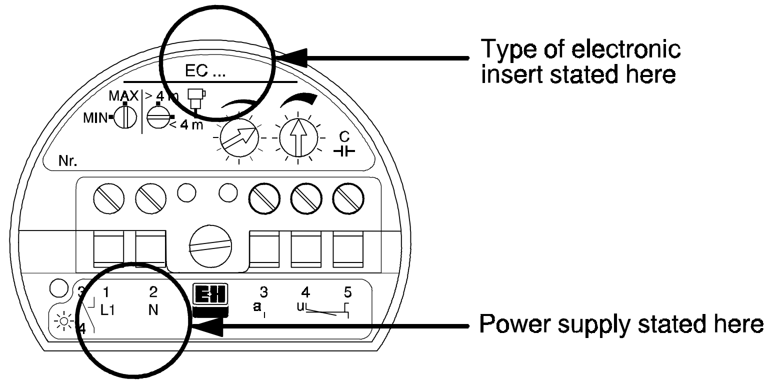


Fig. 18
Note the power voltage stated on the nameplate!

Electrical Connections

Connect the Nivocompact according to the appropriate diagram Fig. 14 to Fig. 17.

Ensure that no water gets into the housing while connecting up.

The gasket in the standard cable gland is designed for cable diameters from 7 mm to 10 mm.
A suitable gasket must also be used for other cable diameters.

You can seal with the »water-tight« cable gland with cables having diameters from 5 mm to 12 mm.

Ensure that there is a good **short ground connection** from the housing of the Nivocompact to the silo or to the counter electrode.
No special ground connection is required if an FTC 131, without sealing material on the thread, is screwed into a metal silo.

After Connecting

Screw the thread of the cable gland securely to comply with the standards of Protection IP 55 or IP 66.

For applications in the open or in moist surroundings, sealing the standard cable gland with sealing compound is also recommended.
(This is not required with the »water-tight« cable gland).

Calibration

Tools Required for Calibration

- Screwdriver with blade width approx. 3 mm
- Screwdriver with blade width approx. 5 mm

The rotary switches and adjusting elements for calibration are on the electronic insert in the housing.
Directly beside these calibration elements are the power connections with voltages up to 250 V.
Only use a screwdriver which has insulation as far as the blade or else tape over the terminals with insulating tape before calibration.

Capacitance Calibration

For capacitance calibration, the silo must be empty or the level of material must be at least 200 mm below the probe.

- Turn on the power supply.
- Carry out the calibration according to the sequence of diagrams Fig. 19 to Fig. 21.
- Ensure that no water gets into the housing while calibrating.

Capacitance Calibration, Initial Settings

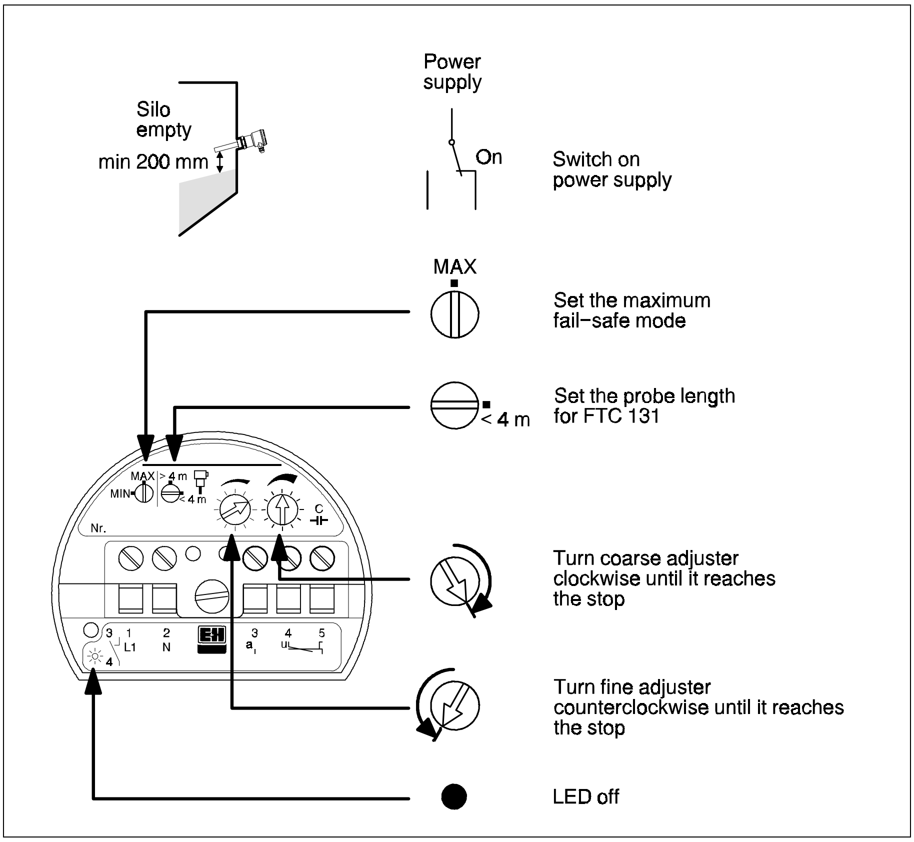


Fig. 19
These initial settings must be done before the capacitance calibration.

Capacitance Calibration

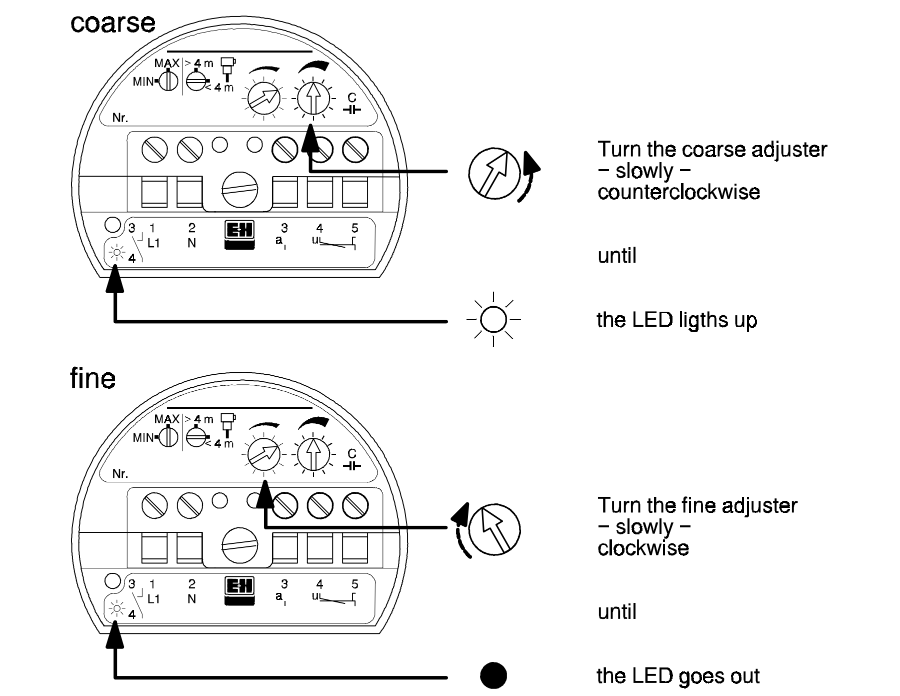
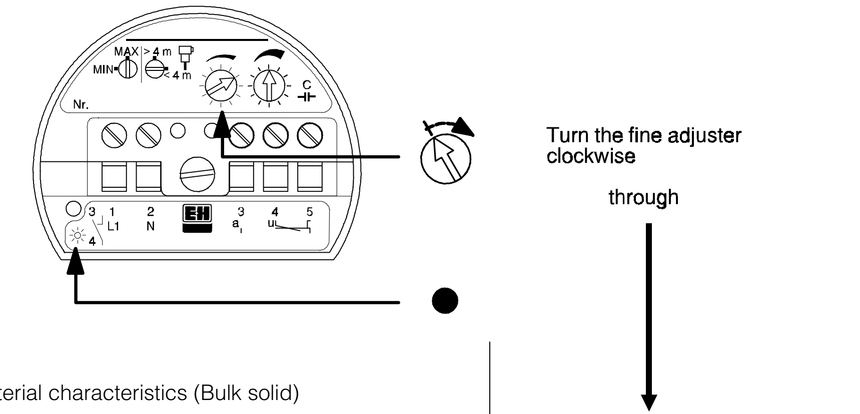


Fig. 20
Capacitance calibration must be carried out both slowly and carefully.

Adjusting for Material Characteristics



Material characteristics (Bulk solid)		
Low dielectric constant, Low conductivity	No build-up	Approx. 1 division
	With build-up	Approx. 1 to 2 divisions
High dielectric constant, high conductivity	No build-up	Approx. 2 to 4 divisions
	With build-up	Approx. 4 to 6 divisions

Fig. 21
Accurate adjustment ensures high switching reliability.

When the probe is covered with non-conductive bulk solid having a low dielectric constant, then the Nivosonic only switches when the rod probe is completely covered with the material.
The degree of covering depends on the calibration.
Turning the fine calibrating element clockwise causes the Nivocompact to become less sensitive.

Safety Switching

By using the rotary switch, select the fail-safe mode for your particular application:

- Maximum fail-safe: The current circuit is blocked if the probe is covered or the power supply fails.
- Minimum fail-safe: The current circuit is blocked if the probe is uncovered or the power supply fails.

Changing the fail-safe mode, also changes the LED status indication.

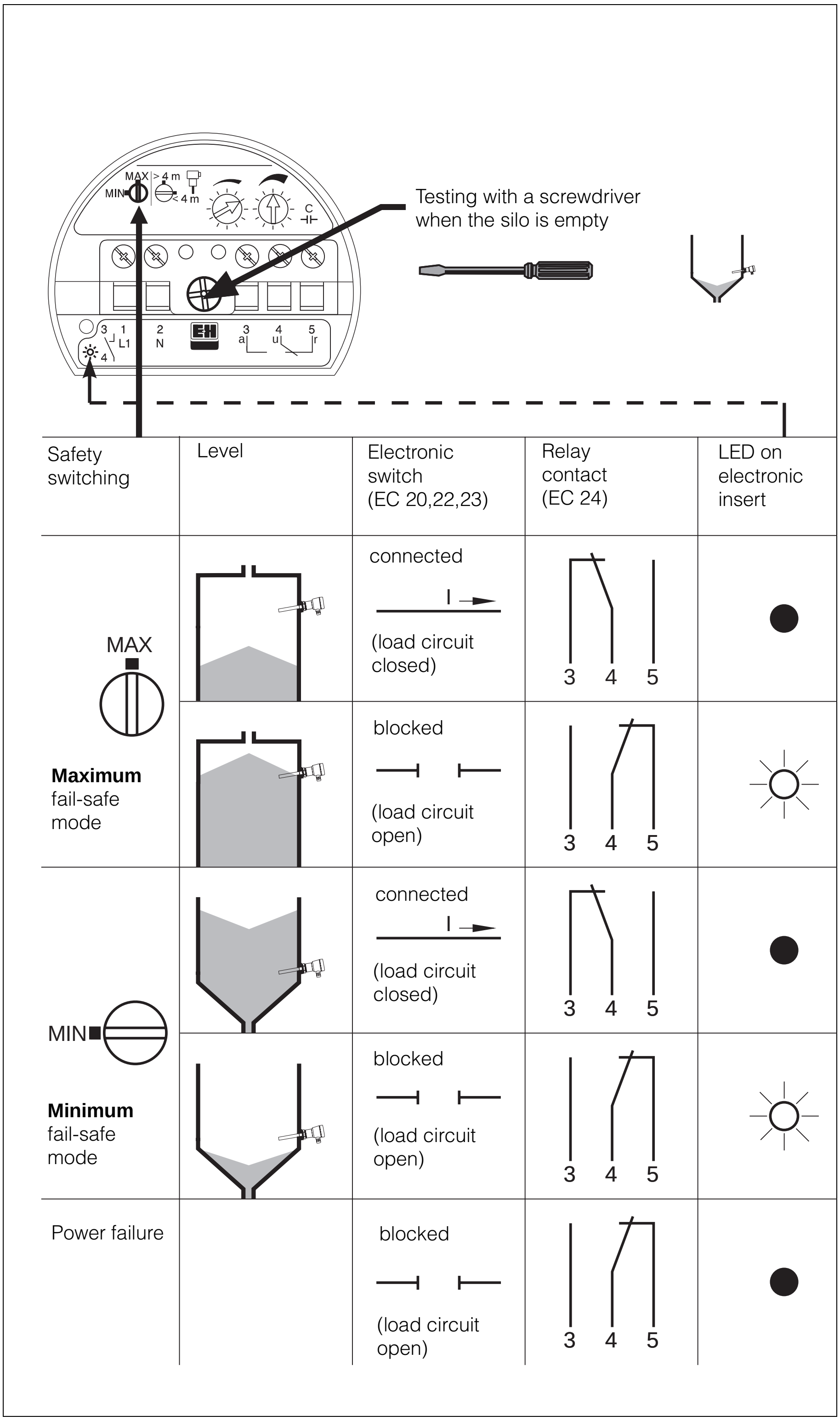


Fig. 22
Selecting the fail-safe mode and function

Function Control

With the probe uncovered, touch the central retaining screw of the electronic insert with a screwdriver, holding it by the insulated handle.
This simulates the bulk solid covering the probe.
The LED indicates a change of status.

This is only a function control test of the instrument.
Please also check for the correct operation for limit detection by filling and emptying the silo at the installation point!

Final Points

Screw the housing cover securely down after connection and calibration so that the standards comply to Protection IP 55 or IP 66.

For applications in the open, a protective sun cover (accessory) is to be used to cover the aluminium housing of the Nivocompact.

Maintenance

The capacitive level limit switch Nivocompact FTC 131 requires no maintenance when correctly installed and used properly under the normal conditions specified by the system.

When cleaning and checking the silos:
- Examine the probe to check for damage to the insulation
- Remove material build-up, especially around the threaded boss.

With one-off but persistent low material build-up:
Recalibrate the Nivocompact after the material build-up has occurred.

Ensure that the cable gland and housing cover are tight fitting so that no moisture can enter.

Troubleshooting

When an error is indicated, first check to make sure that
- The Nivocompact is properly connected
- There is a good ground connection to the silo or to the counter electrode
- A power supply exists at the terminals
- All instruments connected are operating correctly
- In the case of the electronic insert EC 20, the minimum required load of the connected instruments is at least present
- The correct fail-safe mode has been chosen
- Calibration has been carried out correctly (see Calibration)

Carry out a function control (see above)

Refer to the Error Tables, Fig. 23 and Fig. 24.

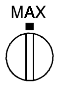
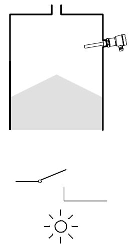
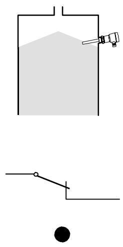
Error with maximum fail-safe mode		Possible causes
Probe free (level below maximum) but with electronic switch blocked LED on		- Water condensing around the threaded boss - High material build-up on the threaded boss - Probe insulation damaged - Water in housing
Probe covered (level above maximum) but with electronic switch connected LED off		- Dielectric constant of the material too small - Drier (or different) material now in Silo than expected on calibration

Fig. 23
Troubleshooting with maximum fail-safe mode.

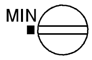
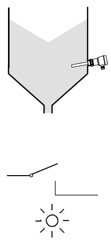
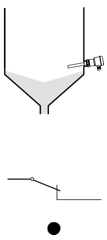
Error with minimum fail-safe mode		Possible causes
Probe covered (level above minimum) but with electronic switch blocked LED on		- Dielectric constant of the material too small - Drier (or different) material now in Silo than expected on calibration - Material has formed cavities
Probe free (level below minimum) but with electronic switch connected LED off		- Water condensing around the threaded boss - High material build-up on the threaded boss - Probe insulation damaged - Water in housing

Fig. 24
Troubleshooting with minimum fail-safe mode.

Guarantee

Our guarantee terms are included with the documents included with delivery. Copies may also be obtained from the agent responsible.
Any modification carried out within the instrument during the guarantee period invalidates the terms of the guarantee.

Replacement of Parts

Replacing the Electronic Insert

Removal

Switch off all sources of power to the Nivocompact.

- Remove the electrical connections to the electronic insert
- Remove the central screw in the electronic insert
- Lift out the electronic insert from the housing using the handle

Insertion

- Push the new electronic insert carefully into the plug in the housing
- Tighten the central screw
- Connect up the electrical wires

Calibration

- Switch on the power supply
- Turn the switch for probe length to the same position as it was on the old electronic insert
- Carry out a new capacitance calibration with an empty silo
- Select the same fail-safe mode as it was for the old electronic insert

Replacing Probe

- If a probe is to be replaced with one of a different length, then a new capacitance calibration must be carried out.

Returning Parts for Repair

If a Nivocompact FTC 131 cannot be repaired and needs to be sent back to Endress+Hauser, then please note the following:

Cleaning the Probe

Remove all material residue attached to the probe.
This is especially important as the material may be of a dangerous nature, e.g. corrosive, poisonous, carcinogenic, radioactive etc.
Please return parts only after they have been throroughly cleaned of dangerous materials. Check in particular scratches and possibility of diffusion through plastic material.

Stating Material and Defect

When returning the probe, please state exactly the material in which it was used and its characteristics.
A brief description of the error will also help us to diagnose the reason for it and at the same time lower your costs.

Thank you for your cooperation.

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